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(54) Improved activity boot.

(57) Disclosed is a boot (16) for an in-line roller skate, said boot (16) including a plurality of elongated fitting apertures (70a - 70f) disposed in the area substantially adjacent to the closing means (58,60). The fitting apertures (70a - 70f) increase the flexibility of the stiff boot material enabling an in-line roller skater to more closely conform the boot to his foot, providing a better fit and increasing performance while reducing fatigue.

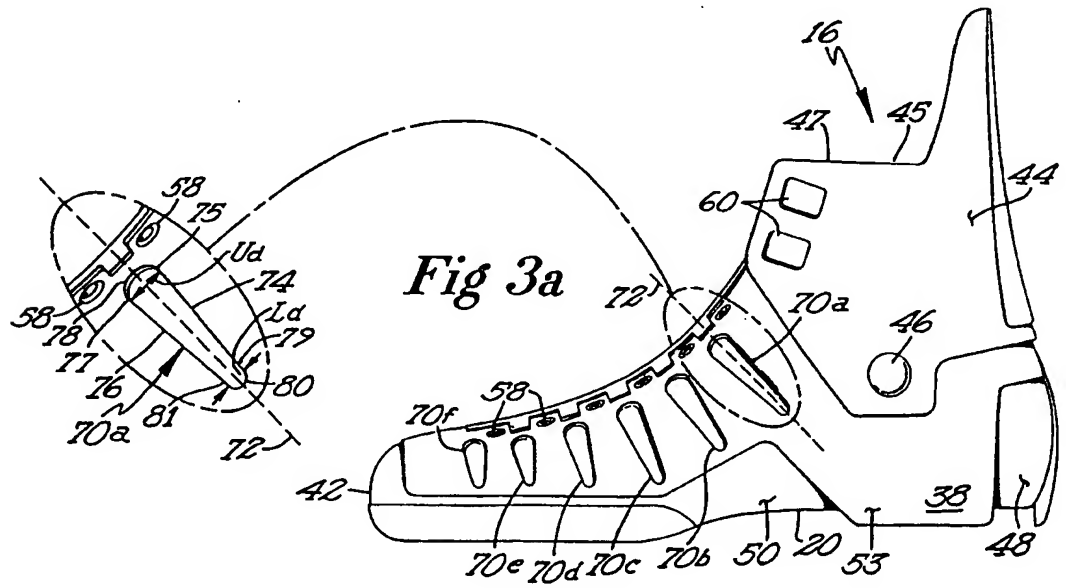

Fig 3a

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The present invention relates generally to activity boots formed of a substantially stiff, synthetic material such as may be found on footwear utilized in activities such as in-line roller-skating, ice-skating, grass or roller-skiing, hiking, and the like.

Traditionally, one of the factors deterring many people from enjoying or even trying such sports as in-line roller skating or ice-skating has been a lack of the ankle strength necessary to balance properly on the set of in-line wheels or on the narrow ice skating blade, respectively. Because the novice had difficulty balancing, he tended to experience falls, and injuries sometimes occurred as a result. To increase participation in such sports and the marketability of equipment therefor, it was incumbent upon manufacturers to increase the support given to a participant's ankles. One accepted method has been to employ a relatively stiff material as the footwear shell rather than a relatively flexible material such as leather or canvas.

The use of a substantially stiff synthetic material such as polyurethane as a shell for activity boots of the just described types serves at least three important functions. First, as noted above, a relatively stiff shell functions to provide increased ankle support by resisting side to side flexing in the ankle region of the footwear. Second, a relatively stiff shell provides increased foot protection due to the shell hardness, an important factor when used in sports such as skiing, ice-skating and roller-skating where falls are common, especially for beginners. Third, such shells are more durable than footwear made of leather or canvas and can better survive the abrasions suffered when employed on the asphalt or concrete surfaces typically utilized by in-line roller skaters.

Such boots are usually constructed to have an overall form similar to what is commonly known as a high top sneaker. That is, the boot includes an extended upper portion that reaches above the ankle, sometimes as high as the mid-calf region of the user, to provide the desired ankle support. This ankle support portion may be integral with the remainder of the boot or can be a separate cuff joined to the boot. Additionally, these boots commonly possess a closure opening that extends along the top front portion of the boot between the area near the toe to the top of the ankle support portion. This opening, as with all such footwear openings, allows a boot to flex open for easy insertion and removal of a foot. Known closure means, such as eyelets for laces, or a plurality of buckle means, for example, are disposed on each side of the closure opening and provide a means to tighten the boot onto the foot. Typically such footwear is sold with a removable liner. The liner serves to protect the foot from chafing caused by the movement of the foot within the boot, the stiffness of the shell, and from the rivets by which the boot may be attached to a blade or frame holding a set of roller wheels.

A disadvantage of this stiff type of activity boot, however, is that the stiffness provided by these shells prevents a close fitting of the footwear to the feet of many users. That is, the stiffness does not allow a boot to conform closely to the shape of a particular user's foot. For example, while a proper fit may be obtained in the heel and the length of the boot, a particular user's low arch may present problems obtaining a completely proper fit because the stiff shell prevents the boot from being tightened down upon the midfoot/arch region. This problem has its origin in the fact that, to be cost effective in the use of a stiff shell, manufacturers must manufacture them so that each shell fits a certain prescribed range of foot sizes. Obviously, some feet, particularly those at the upper end of a particular size range, may fit a particular boot better than others. Feet vary enough individually, however, that even larger feet in a particular size range may not achieve the desired fit because the stiffness of the material prevents a close conformance to the foot from being secured in the desired regions.

Because shell stiffness prevents a tight fit from being readily obtained, there is "slippage" in the boot; that is, the stiffness allows for motion of the foot relative to the footwear shell as well as internal motion of the various and plentiful foot bones relative to each other, particularly in the midfoot region. "Midfoot" in this context includes the cuneiform, cuboid, navicular, and metatarsal bones, and the related tissue areas. In ordinary terminology, the area of the midfoot extends generally from the ankle forward to the toes.

The relative motions in the mid-foot can produce user discomfort as well as an energy loss and a consequent reduction in muscular efficiency. These motions could be eliminated by individually molding shells around a foot to completely personalize the fit of a boot. Such a boot would not be cost effective for the mass market, however. Thus a market need exists to provide an activity boot comprising a substantially stiff, synthetic material that provides the additional ankle support needed by the majority of users and a better fit across the spectrum of users of a particular size of boot. Such a boot must be flexible enough to suit the variability of the human foot and still provide the stiffness in those shell areas where usage creates large forces. These shell areas include the sole, the heel, the ankle, and the lateral bone of the mid-foot. Flexibility should be provided in the side and top of the mid-foot area to hold the foot down against the inner sole by enabling the boot to be cinched up around the varying foot heights and widths in this area. Better fitting foot wear would provide additional comfort, reduce relative motion between the boot and the foot, thereby transferring more energy into motion and thereby reducing user fatigue, provide a user with better overall balance, and provide a user with better overall control over the position of the footwear.

It is a principle object of the present invention to provide a new and improved activity boot that is not

subject to the foregoing disadvantages.

It is another object of the present invention to provide a better fitting activity boot for use on in-line roller-skates, ice-skates, ski boots, and the like.

It is a further object of the present invention to provide a better fitting activity boot that provides a user with greater control, that is more comfortable to the user, and that is less fatiguing to the user.

According to the present invention there is provided an improved activity boot providing a better fit, selectively improved flexibility, improved performance, and reduced weight, said boot comprising a stiff shell including an upper band, said upper band defined in part by an ankle section and a mid-foot section extending substantially from said ankle section forward to the front of said boot, said upper band including an upright opening extending from said ankle section to said front of said boot and including closure means selectively disposed along said opening for at least partially closing said opening, whereby said boot may be tightened onto a foot, the improvement comprising:

a plurality of upright, elongated fitting apertures selectively disposed longitudinally along said mid-foot section,

whereby said fitting apertures add flexibility to said stiff shell where it is desired to provide a close conformance to a user's foot while retaining stiffness in desired locations.

The present invention provides an activity boot having an improved fit and a method of manufacturing the same. The boot includes a substantially stiff shell having an upper shell portion including a mid-foot section. The mid-foot section includes a plurality of elongated apertures, each aperture having a longitudinal axis oriented along a line extending between the boot closure means and the sole of the boot. In a preferred embodiment each of the plurality of apertures is selectively centrally located in an area defined in part by adjacent closure means.

Disclosed also is a method of manufacturing such a boot comprising the steps of manufacturing the shell of the boot, determining the direction of stress forces along a line connecting the closure means, and cutting a plurality of elongated apertures in the boot, each of the apertures being orientated such that the major axis of each aperture lies parallel to the line of greatest force in the vicinity of the aperture.

These and other objects of the present invention will become apparent to those skilled in the art when the following detailed description of the invention and claims are read in conjunction with the accompanying drawings. Throughout the specification identical reference numerals refer to identical or similar parts.

By way of example, embodiments of the invention will now be described with reference to the accompanying drawings, of which:

Figure 1 is a perspective view of an in-line roller-skate including an activity boot embodying the present invention.

Figure 2 shows a perspective view of an activity boot of the type shown in Figure 1,

Figure 3a is a side elevation view of the boot of Figure 2,

Figure 3b shows in a side elevation an alternative embodiment of the present invention,

Figure 4 depicts one method of determining the proper location and orientation of the fitting apertures of the present invention,

Figure 1 shows an in-line roller-skate 10 having a boot 16 of the type in which the present invention may find application. Boot 16 is manufactured from a substantially stiff material such as polyurethane and is mounted to a frame 12 carrying wheels 14a, 14b, 14c, and 14d respectively. As depicted, the skate includes a brake assembly 18 that may be used by a skater to stop. Frame 12 is attached to boot sole 20 by known attachment means, such as rivets 22. Thus, frame 12 is attached to boot sole 20 with a front sole plate 24 at a front sole location 26 and with a rear sole plate 28 at a rear sole location 30. Frame 12 rotatably supports wheels 14a, 14b, 14c, and 14d. While the in-line roller-skate shown in Figure 1 is typical of those commonly found in today's market, a more complete description of an exemplary boot can be found in U.S. Patent 4,909,523, assigned to the same assignee as the present invention.

Referring now to Figure 2, boot 16 includes a boot upper 36 integral with sole 20. Boot upper 36 comprises a lower, protective band 38 extending upwardly from sole 20 and an upper band 40 extending upwardly from band 38 to the top of the boot. Band 38 provides necessary stiffness and resistance to lateral bending in the lower portion of boot 16. Band 38 is the area most subject to stresses arising from the use of boot 16 on an in-line roller skate or the like. Additionally, it protects the foot from damaging impacts due to falls.

Upper band 40 includes a mid-foot section 42 and an ankle supporting cuff section 44. Support section 44 is a separate piece of material of the same the forming boot 16. Supporting section 44 is pivotally attached to the boot at a pivot 46 disposed approximately ankle high near the front side of the boot. Midfoot section 42 extends forward from supporting section 44 to the front of boot 16.

Boot 16 includes a foot insertion opening is disposed at the top 47 of the boot. A closure opening 49 extends from foot insertion opening 45 forwardly to a boot toe 52. Closure opening 49 facilitates insertion and removal of a foot into and out of boot 16 and defines a left side 51 and a right side 53 of boot 16. Boot 16 includes means for closure such as lace eyelets 58 and bosses 60 whereby boot 16 may be laced tightly around a foot. Other closure means such as buckles, are known in the art and are equally func-

tional on a boot employing the present invention though they form no part thereof. The lower protective band 38 includes a heel portion 48, an arch 50, and a boot toe 52.

Referring now to Figure 3a boot 16 has a plurality of similar, but not necessarily identical, elongated fitting apertures 70a-70f formed in the mid-foot region of the boot. Each of the apertures includes a pair of sides 74 and 76 that symmetrically diverge from a longitudinal axis 72 of the aperture from the bottom of the foot towards the closure means. Sides 74 and 76 are joined at their closest confluence by a lower corner 80 and at their point of widest divergence by an upper corner 78. Preferably corners 78 and 80 approximate semi-circles wherein upper corner 78 has a diameter U_d and lower corner 80 has a diameter L_d. The ratio of L_d to U_d generally should be no greater than 3 to 4.

More generally, each aperture is defined in part by a pair of lateral sides 74 and 76, each lateral side 74, 76 having top ends 75, and 77 respectively and bottoms end 79 and 81 respectively. Bottom ends 79 and 81 are spaced a distance L_d apart while top ends 75 and 77 are spaced a distance U_d apart, where $L_d < U_d$. Lateral sides 74 and 76 are connected by a top side 78 joining top ends 75 and 77 respectively. A bottom side 80 joins bottom ends 79 and 81 of lateral sides 74, 76 respectively. Top and bottom sides 78 and 80 preferably have a curved configuration. Such a curved configuration need not be of a circular nature but could also be any curve that provides the upper and lower corners with rounded rather than angled corners.

Apertures 70a-70f are shown having the same basic geometrical shape, but of differing size. It is easily observed that aperture 70a is slightly longer than aperture 70b, that aperture 70b is slightly longer than aperture 70c, an so on. While the lengths of the apertures grow shorter from rear to front, the distances U_d and L_d remain substantially equal from aperture to aperture.

Fitting apertures such as those shown in Figures 3a and 3b are preferred over other configurations because the limited number of symmetry axes thereof provides directional properties. Thus, flexibility can be provided in desired directions rather than in all directions. Additionally, it is preferred that the fitting apertures are oriented with their longitudinal axis directed substantially parallel to the stress forces created within the boot by the closure means, rather than at an angle thereto to reduce the likelihood of material failure.

The presence of apertures 70a-70f decreases the overall stiffness of the material forming boot 16 in the mid-foot region, thereby providing a tighter fit around the bones of the mid-foot. That is, removal of the boot material in the locations of the various apertures enables the boot to flex more readily in the vicinity of each of the apertures. Each individual aperture then provides a localized area of extra pliancy in the area surrounding it as well as increases the overall flexibility in the mid-foot region. This additional flexure enables a boot user to close a boot more tightly in this region, thereby restraining both the relative amount of motion between the boot and the foot as well as between the bones of the mid-foot. While laces are the most commonly used kind of closure means, buckles further enable a user to obtain a tight but comfortable fit since each buckle is typically capable of being individually and locally adjusted whereas laces ultimately draw with a uniform tightness across the entire foot.

Thus, with apertures 70 located as shown in Figure 3a closure means such as lacing through eyelets 58 or buckles (not shown) may be more tightly drawn, thereby more closely confining individual feet and hence reducing the amount of relative motion between both the foot and the boot and the bones of the mid foot region with themselves. Because less energy is lost due to the relative motions just listed, additional energy is transmitted to the ground during push-off, the user can skate further and faster for the expenditure of the same amount of energy, the user is better able to control the position of his footwear, and in addition, the user is provided with better balance. Finally, a boot such as that depicted in Figure 3a provides a user with a more comfortable fit.

An alternative embodiment of the present invention is shown in Figure 3b. Contrasting Figures 3a and 3b, it can be seen that each aperture 70 of Figure 3a is positioned such that its longitudinal axis substantially bisects a chord drawn between adjacent enclosure means, in this case eyelets 58. In Figure 3b however apertures 71a-71f of boot 16a are disposed such that each longitudinal axis of an aperture is aligned with the center of an eyelet 58. In all other respects, apertures 71a-71f are similar to apertures 70a-70f. The positioning of the apertures shown in Figure 3b, however, is not preferred since that particular embodiment results in greater stresses within the boot than the preferred embodiment shown in Figure 3a.

As noted previously, while the apertures shown in Figures 3a and 3b are shown having curved upper and lower corners, the present invention contemplates the use of corners of other configuration. The use of curved corners, particularly those having a substantially semi-circular configuration, is preferred because boot cracking and failure modes are reduced. Thus while other shapes may be employed and fall within the scope of the present invention, such other shapes may increase the likelihood of boot cracking and deterioration.

Each boot aperture is configured such that a larger amount of material is removed from the uppermost portion of the aperture. Thus, as shown in Figures 3a and 3b, each apertures tapers from a wider top portion to a narrower bottom portion. Across the

length of the boot, then, from front to back, progressively lesser material is removed from boot 16 as one progresses from the top of the boot toward the sole area. Because flexibility is related to that amount of boot material present in a particular area, this particular configuration of the apertures retains the rigidity needed in the sole area of the boot to firmly hold the foot while allowing flexibility at the top of the boot such that it may be closely fitted over the top of the foot. Utilization of slots having a larger width results in more flexible boots than those boots which have slots of a relatively narrow width. The present invention contemplates varying the slot widths from top to bottom to achieve the desired flexibility and stiffness characteristics for the particular use in which the boot is found. Care must be taken to avoid making the fitting apertures too large or having too many since that would reduce the lateral support that the boot is intended to provide. Furthermore, apertures which are too small or too few in number will not provide the desired flexibility to enable a boot to be closely conformed to a user's foot. Preferably, the number of fitting apertures should not exceed n+l, where n is equal to the number of closure means, i.e., lace eyelets or buckles.

The size of the apertures will naturally vary with the size of boot upon which they are placed also, and, therefore, precise measurements for a particular boot cannot be given. By way of example, it has been found that the diameter of the upper corner of a size 13 boot should not exceed 1.3cm(1/2 inch) while the diameter of the lower corner of the same size boot should be not larger than 1.0 cm (3/8 inch).

Figure 4 represents in a side view a relative positioning of the eyelets shown in Figures 3a and 3b and depicts a method of determining the proper orientation of the apertures relative to the boot shown in Figures 3a and 3b. First, a curved line 82 is drawn through the center of the closure means, here eyelets 58. Second, a tangent line 84 to curved line 82 is drawn through a point below which an aperture is to be located. An orientation line 86 is then drawn perpendicular to tangent line 84 through the same point. A properly oriented aperture 88 will have its major or longitudinal axis 89 lying substantially coincident with orientation line 86. An improperly oriented aperture 90 will have its major axis 91 lying at an angle to orientation line 86. Slight angular deviations from perfect colinearity are within the scope of the invention, although such deviations can alter the useful life of the boot.

The apertures shown have been selectively located in the mid-foot region of boot 16 only. Because boot flexibility increases with the proper placement and number of fitting apertures, a distribution of apertures is not recommended in the areas immediately adjacent the sole 20 of the boot, such as lower protective band 38. The boot must remain stiff in this area in order to support the roller means or skating blade attached to the sole. Furthermore, the boot must also be stiff at the base and sides of the heel portion 48 so that the rear portion of the user's foot does not slip within the boot. In general terms then, adding apertures in lower portion 38 is not advisable since that results in reduced stiffness where stiffness is desirable. In addition, it would be unwise to place apertures in the ankle support portion 44 since the increased flexibility that would result would reduce the ankle support most users find both necessary and comfortable.

While the present invention has been described in relation to a boot useful in an in-line roller-skating application, it could also find application in other kinds of activity boots using a substantially stiff shell to provide additional ankle support and wherein a tight fit is desirable. Furthermore, while a preferred embodiment of the shape of the apertures of the present invention has been described, apertures having configurations and which are located along the mid-foot region near the closure means are also within the scope of the present invention.

As described, the apertures of the present invention will provide an activity boot having improved flexibility, improved performance, greater user comfort, and will conform better to the individual foot. In addition, the presence of the apertures results in a lighter boot due to removal of the shell material formed the apertures with little or no extra manufacturing costs. This weight reduction further results in an improvement in performance and user efficiency and comfort over and above that provided by the better fitting boot that results from the addition of the apertures thereto. Further all of these salutary goals can be accomplished without a reduction in ankle support that the beginner and even experienced users find necessary or helpful in performing certain activities. It is within the scope of the present invention, however, that the present invention may also find application on an activity boot excluding ankle supporting cuff portion 44, thereby providing desirable flexibility in stiff shell footwear formed for activities where ankle support is not as necessary as it is in in-line roller skating.

Having thus described the present invention, additional numerous changes, substitutions, modifications and alterations may now suggest themselves to those skilled in the art, all of which fall within the spirit and scope of the present invention. Accordingly, it is intended that the invention be limited only by the scope of the appended claims.

Claims

1. An improved activity boot providing a better fit, selectively improved flexibility, improved performance, and reduced weight, said boot comprising

a stiff shell including an upper band, said upper band defined in part by an ankle section and a mid-foot section extending substantially from said ankle section forward to the front of said boot, said upper band including an upright opening extending from said ankle section to said front of said boot and including closure means selectively disposed along said opening for at least partially closing said opening, whereby said boot may be tightened onto a foot, the improvement comprising:

a plurality of upright, elongated fitting apertures selectively disposed longitudinally along said midfoot section,

whereby said fitting apertures add flexibility to said stiff shell where it is desired to provide a close conformance to a user's foot while retaining stiffness in desired locations.

2. The improved boot of claim 1 wherein at least one of said fitting apertures is partially defined by a pair of lateral sides extending symmetrically about a longitudinal axis, each of said lateral sides having upper and lower ends and said lower ends of said lateral sides being a distance d_1 apart from each other and said upper ends of said lateral sides being a distance d_2 apart from each other, where $d_2 > d_1$, said aperture being further defined by an upper edge joining said top ends of said lateral sides and a bottom edge joining said bottom ends of said lateral sides, said top and bottom sides having a curved configuration.

3. The improved boot of claim 2 wherein the ratio of d_1 to d_2 is less than 3:4.

4. The improved boot of claim 2 or claim 3, wherein the longitudinal axis is coincident with an imaginary orientation line, said orientation line extending from said opening and ending adjacent the sole of the boot and being disposed midway between adjacent closure means.

5. The improved boot of claim 4 wherein said orientation line is coincident with a line between adjacent closure means and extends in the direction of greatest stress in said midfoot section.

6. The improved boot of claim 2 or claim 3 wherein said longitudinal axis is coincident with an imaginary orientation line that extends from said opening and ends adjacent the sole of the boot and wherein said orientation line bisects a closure means.

7. The improved boot of claim 6 wherein said orientation line is coincident with a line bisecting said closure means extending in the direction of greatest stress in said midfoot section.

8. An improved in-line roller skate, said skate including a frame carrying a plurality of rollers and further including a boot providing a better fit, improved flexibility, improved performance, and reduced weight, said boot comprising a stiff shell and including a sole portion, said frame attached to said sole portion, said shell further comprising and an upper band, said upper band defined in part by an ankle section and a mid-foot section extending substantially from said ankle section forward to the front of said boot, said upper band including an opening extending from said ankle section to said front of said boot and including closure means selectively disposed along said opening for at least partially closing said opening, whereby said boot may be tightened onto a foot, the improvement comprising:

a plurality of upright, elongated fitting apertures selectively disposed longitudinally along said midfoot section, each of said apertures having a longitudinal axis and oriented such that its longitudinal axis lies along an imaginary orientation line extending from said opening and ending at said sole.

9. The improved skate of claim 8 wherein at least one of said apertures has an upper edge configured substantially as a semi-circle having a predetermined diameter and a lower edge, said upper and lower edges having ends connected by substantially straight lines.

10. The skate boot of claim 8 or claim 9, wherein at least one of said apertures has an upper edge and a lower edge configured substantially as a semi-circle having a predetermined diameter, said upper and lower edges having ends connected by substantially straight lines.

11. The improved skate of claim 10 when dependent on claim 9, wherein the said diameter of said upper edge is greater than said diameter of said lower edge.

12. The improved boot of claim 11 wherein the ratio of said minor diameter to said major diameter is less than 3:4.

13. The improved skate of any one of claims 8 to 12 wherein each said orientation line extends through a point disposed midway between adjacent closure means.

14. The improved skate of claim 13 wherein each said orientation line is coincident with a line extending in the direction of greatest stress in

said midfoot section.

15. The improved skate of claim 8 wherein each said orientation line bisects a closure means.

16. The improved skate of claim 15 wherein said orientation line is coincident with a line extending in the direction of greatest stress in said midfoot section.

17. The improved skate of any one of claims 8 to 16, wherein said boot further includes an ankle supporting cuff portion.

18. A method for determining a position for an elongated fitting aperture disposed on an improved activity boot, said fitting aperture having a longitudinal axis, said boot providing a better fit, increased flexibility, improved performance and a reduced weight, said boot comprising a stiff shell, said boot having a sole and an upper band defined in part by an ankle section and a mid-foot section extending substantially from said ankle section forward to the front of said boot, said upper band including an upright opening extending from said ankle section to said front of said boot and including closure means selectively disposed along said opening for at least partially closing said opening, whereby said boot may be tightened onto a foot, said method comprising the steps of:

a. determining the curve passing through the center of said closure means;

b. determining a tangent line passing through a selected point on said curve;

c. locating an orientation line passing through said selected point perpendicular to said tangent line; and

d. determining said position by said oriented fitting aperture such that its longitudinal axis is substantially coincident with said orientation line and such that said fitting aperture is disposed in said upper band.

19. The improved boot of claim 18 wherein the configuration of at least one of said apertures is partially defined by a pair of lateral sides symmetrically extending about said orientation line, each of said lateral sides having upper and lower ends, the lower ends of said lateral sides being a distance d_1 apart and the upper ends of said lateral sides being a distance d_2 apart, wherein $d_2 > d_1$, said aperture being further defined by a top side joining said upper ends of said lateral sides and a bottom side joining said lower ends of said lateral sides, said top and bottom sides having a curved configuration.

20. The method of claim 19 wherein the ratio d_1 to d_2 is less than 3:4.

21. The method of claim 19 or claim 20 wherein at least one of said top and bottom sides is configured substantially as a semi-circle.

22. The method of any one of claims 18 to 21 wherein said selected point lies substantially midway betwen a pair of adjacent closure means.

23. The method of any one of claims 18 to 21 wherein said selected point is chosen such that said orientation line bisects a closure means.

24. An activity boot comprising a shell of relatively stiff material including an upper band, said upper band defined in part by an ankle section and a mid-foot section extending substantially from said angle section forward to the front of said boot, said upper band including an opening extending from said ankle section to said front of said boot and including closure means disposed along said opening for at least partially closing said opening to tighten said boot onto a foot; characterised in that the boot includes

a plurality of upright, elongate apertures disposed along said midfoot section, to increase selectively the flexibility of that section, thereby allowing the shell to provide a close conformance to a user's foot while retaining stiffness in desired locations.

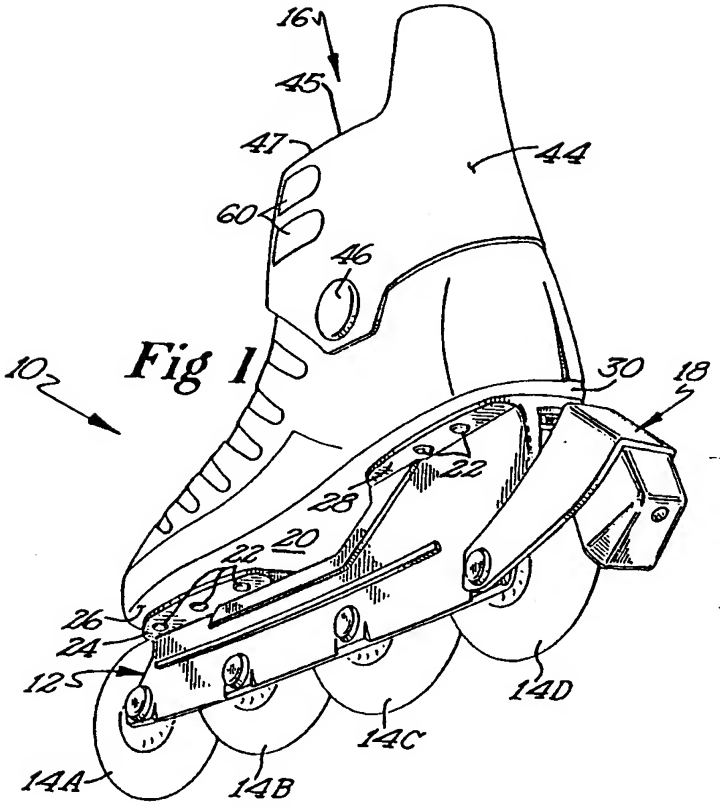
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Fig 1

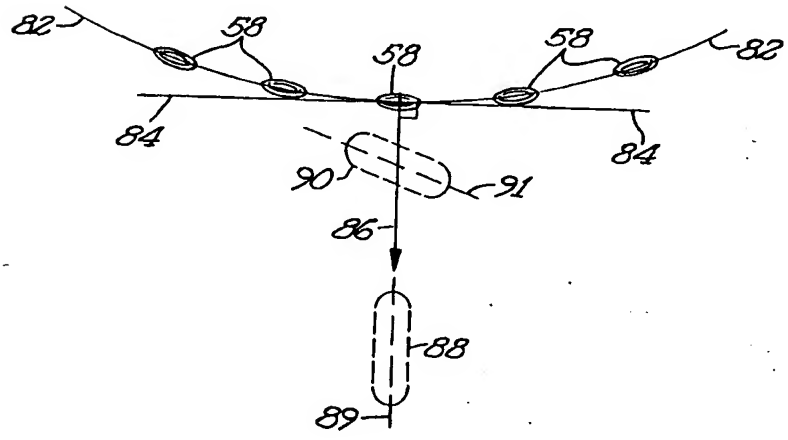
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Fig 4

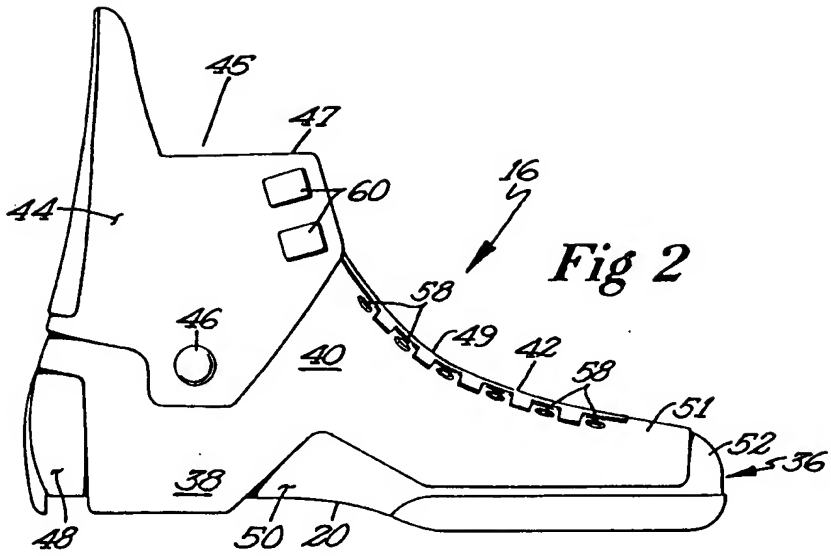

Fig 2

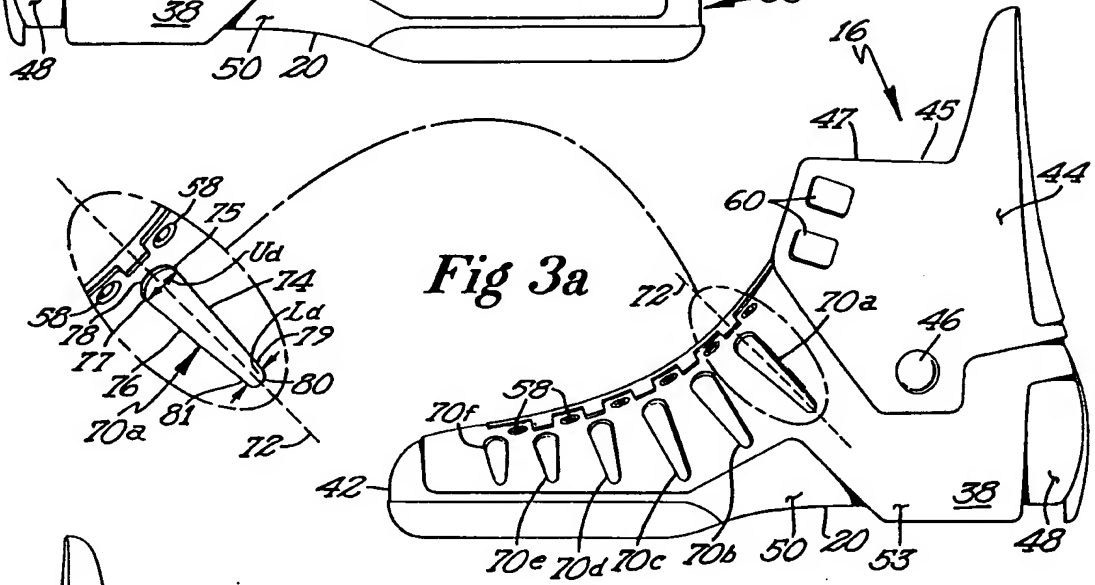

Fig 3a

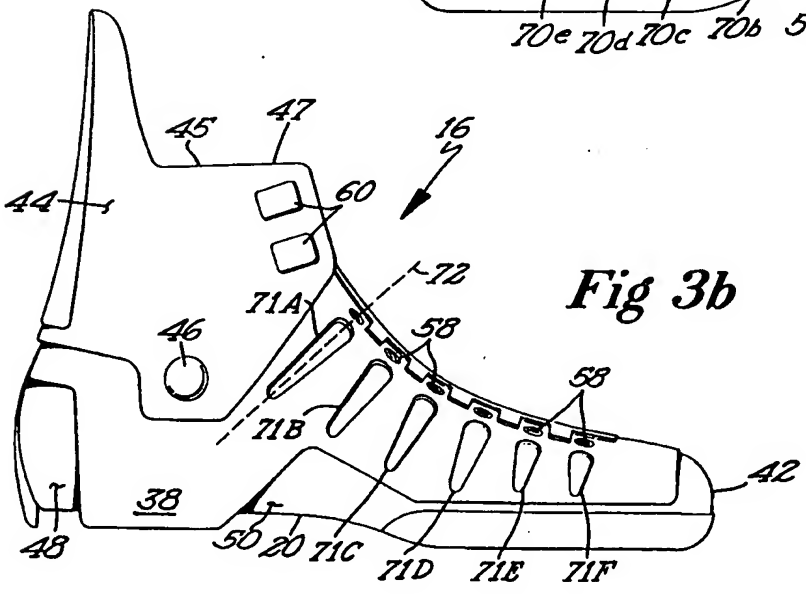

Fig 3b